

NEW WESTERN NEARCTIC *SWELTSA*
(PLECOPTERA: CHLOROPERLIDAE)

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Abstract.—New species *Sweltsa resima*, *Sweltsa cristata*, *Sweltsa umbonata* and *Sweltsa adamantea* are described and compared with their closest relatives.

Key Words: Plecoptera, Chloroperlidae, *Sweltsa*, Nearctic

The following four new species of the stonefly genus *Sweltsa* Ricker (Plecoptera: Chloroperlidae) were discovered during examination of numerous collections of the genus from throughout western North America. Information on similarities and differences between each new species and the rest of its group accompanies descriptions in advance of publication of further revisionary studies.

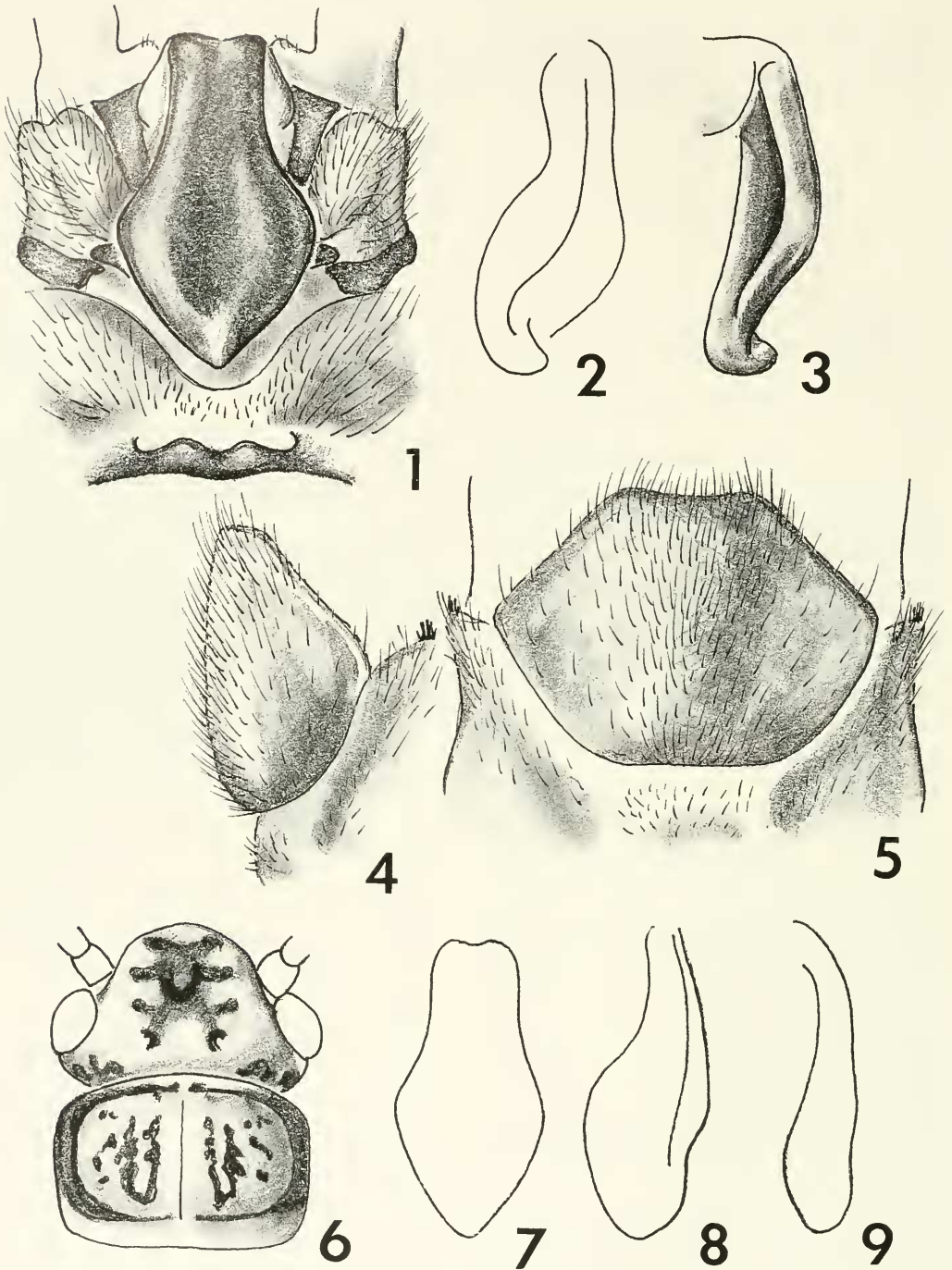
Sweltsa, found in the eastern Palearctic and the Nearctic, is one of three genera in tribe Alloperlini of subfamily Chloroperlinae. They are small- to medium-sized, yellowish stoneflies with a dark abdominal stripe and distinct dark marks on head and nota. The genus is particularly recognized by the recurved epiproct that is composed of the basal bar, widened anteriorly into a cupped anchor, and the hinged, sculptured epiproct tip, extending anteriorly to a transverse ridge on deeply incurved tergum nine (Surdick 1985). The subgenital plate of the female is slightly convex and usually basically hexagonal.

Surdick (1985) gives a key to Nearctic chloroperlinid genera and a list including western Nearctic *Sweltsa* species. Baumann, Gaufin, and Surdick (1977) give a key to most Rocky Mountain and Pacific Northwest *Sweltsa* and Jewett (1960) gives one for most California *Sweltsa*.

Sweltsa resima, sp. nov.
Figs. 1-6

Adult.—General color darkly-marked tan in alcohol. Head with 3 dark ocellar rings, dark rugulae in dusky environs anterior to and adjacent to ocellar triangle and posterior to compound eyes. Pronotum with broad dark explanate margin, dark longitudinal rugulae, median longitudinal unmarked area one-fourth width of pronotum. Meso- and metanota dusky, each with dark recurrent scutoscutellar suture. Abdomen with dark median longitudinal stripe from tergum 1 to 8, single dark lateral stripes from segment 1 to 5, lateral pectens on segments 7, 8, 9. Macropterous; wings hyaline, dark-veined, representative of genus.

Male.—Body length 8 mm; forewing length 9 mm. Epiproct sclerotized, hinged, with tip extending anteriorly to prominent sclerotized deeply crenate transverse ridge on anterior of tergum 9. In dorsal aspect, epiproct tip lozenge, twice as long as wide; verge curved ventrad; median longitudinal furrow ending at recurved apex. In lateral aspect of epiproct tip, distal half of dorsal face declivent 45 degrees; apex recurved, conical; verso of furrow visible beneath verge. Basal anchor of epiproct broadly and deeply scoop-like, notched anteriorly; epiproct support structures otherwise repre-



Figs. 1-9. *Sweltsa resima*. 1, Male terminalia, dorsal aspect. 2, Epiproct tip, dorsolateral aspect. 3, Epiproct tip, lateral aspect. 4, Subgenital plate of female, lateral aspect. 5, Subgenital plate, ventral aspect. 6, Adult head and pronotum. *Sweltsa townesi*, epiproct tip. 7, Dorsal aspect. 8, Dorsolateral aspect. 9, Lateral aspect.

sentative of genus as are segment 9, hemiterga of segment 10. Aedeagus membranous.

Female.—Body length 9 mm; forewing length 9 mm. Subgenital plate dusky, entire, crudely hexagonal, as long as wide, based centrally on sternite 8, evenly hirsute with longer hairs posteromedially, distinguishable anteriorly by narrow membranous periphery; posterior half flap-like, extending over most of sternite 9; profile planate but distinctly elevated. Vagina membranous.

Material.—Holotype ♂, allotype ♀ (U.S. National Museum): California, Inyo Co., Whitney Portal 15-VI-1966 D. C. Rentz. Paratypes: 1 ♂, 1 ♀ (R. F. Surdick) California, Mono Co., Lee Vining Creek, Tioga Pass 15-VII-1979 R. W. Surdick; 2 ♂ (Brigham Young Univ.) California, Inyo Co., Coyote Crk. 11 mi. SSW of Bishop, 1000 ft. 4-VII-1986 D. Giuliani; 2 ♂, 2 ♀ (Brigham Young Univ.) California, Mono Co., Glass Crk. Meadows, Sierra Nevada, 9000 ft. 20-VII-1990 D. Giuliani; 1 ♂, 1 ♀ (Brigham Young Univ.) same locality 28-VI-1990 D. Giuliani; 1 ♂ (Brigham Young Univ.) California, Mono Co., White Mountains, Lone Tree Crk., 6400 ft. 23-VII-1985 D. Giuliani. Other material: 2 ♂, 2 ♀ (S. G. Jewett, Jr.) California, Inyo Co., Lone Pine 28-VII-1940 L. J. Lipovsky, R. H. Beamer.

Compared material.—*Sweltsa townesi*: holotype ♂, allotype ♀ (Illinois Natural History Survey); specimens from El Dorado, Nevada, Placer, Plumas, Sierra, Tehama, Tuolumne Cos., California (Brigham Young Univ., Field Museum of Natural History, A. R. Gaufin, R. E. Hill, S. G. Jewett, Jr., W. E. Ricker, Royal Ontario Museum, B. P. Stark, R. F. Surdick, Univ. of California at Riverside, Univ. of Kansas, U.S. National Museum).

Etymology.—The adjective *resima* means turned up and bent back and describes the tip of the epiproct.

Diagnosis.—This species is closely related to *Sweltsa townesi* (Ricker) 1952 (Figs. 7–9). Cursorily, the dorsal aspects of the epiproct tips of the species look the same.

In lateral aspect, the differences are evident: the epiproct tip of *S. townesi* resembles a partially ballooned version of the epiproct tip of *S. resima* without the conical, up-turned apex. The subgenital plates of the species are similar. The pronota both bear a distinctive broad dark marginal ring.

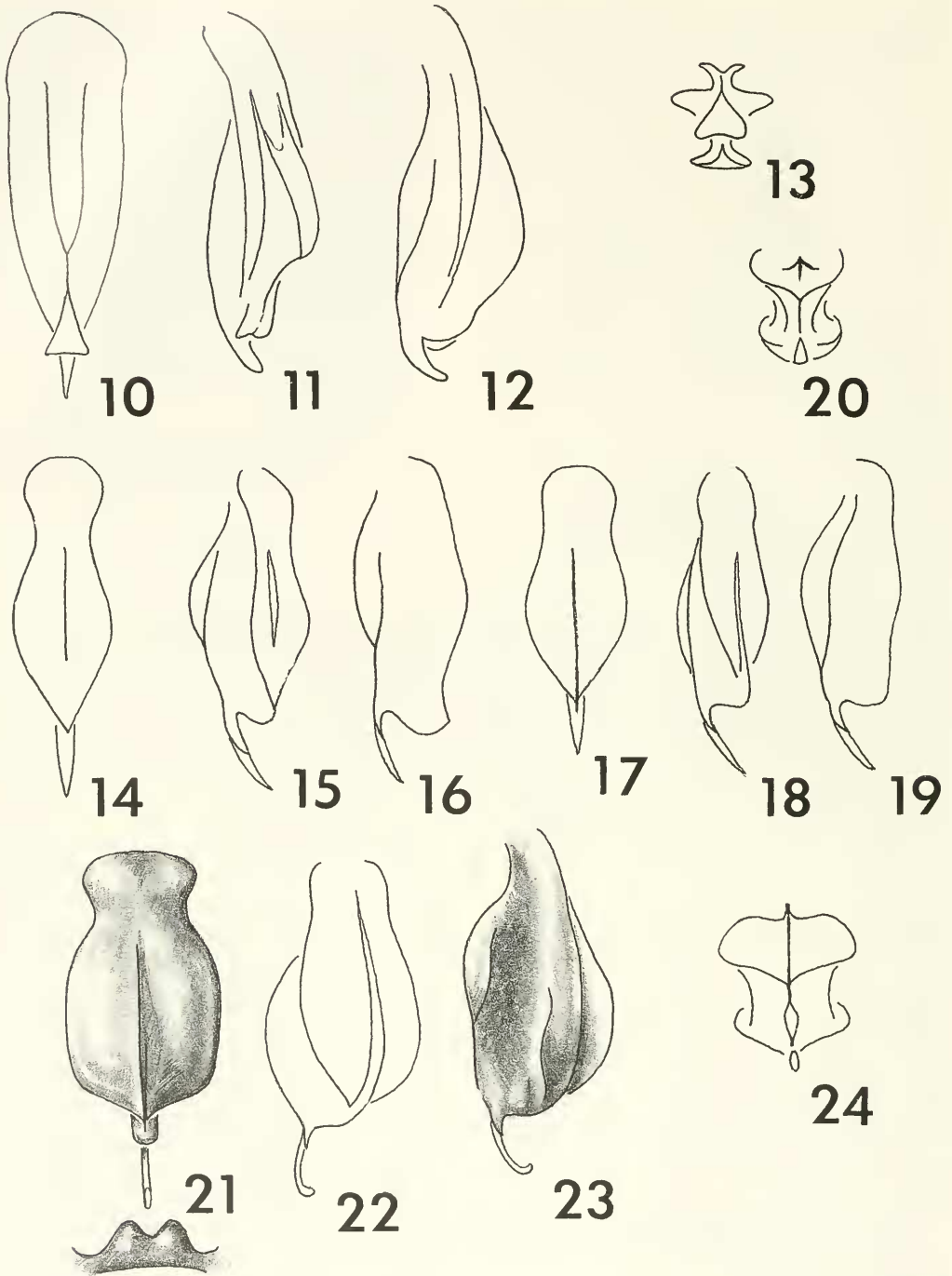
Sweltsa resima has been found on the Great Basin side of the Sierra Nevada south of the Mono Lake area. *Sweltsa townesi* has been found in the northern Sierra Nevada.

Sweltsa cristata, sp. nov.

Figs. 21–24, 40, 42–44

Adult.—General color dusky-marked light tan in alcohol. Head with 3 dark ocellar rings, small dusky rugulae anterior to and adjacent to ocellar triangle and posterior to compound eyes. Pronotum with thin dark encircling line, thin dusky longitudinal rugulae. Meso- and metanota each with dark recurrent scutoscuteellar suture, dusky areas. Abdomen with dark median longitudinal stripe from tergum 1 to 8, single dusky lateral stripes from segment 1 to 3, lateral pectens on segments 7, 8, 9. Macropterous; wings hyaline, dusky-veined, representative of genus.

Male.—Body length 7 mm; forewing length 7.5 mm. Epiproct sclerotized, hinged, with tip deeply sculptured, crudely prismoid, extending anteriorly to deeply crenate transverse ridge on anterior of tergum 9. In dorsal aspect of epiproct tip, proximal three-fourths a slightly undulating horizontal elongately pandurate plane constricted to half width basad of median, obtuse-angulate distally, with greatest width half length; middle portion a barely visible projection of bulk, blunt distally, as long as wide; distal fourth filamentous. In lateral aspect, bulk of epiproct tip cuneate, appearing to intersect three-fourths of slightly declivent horizontal plane forming an arced dorsal crest one-fourth height of epiproct tip; slightly excurved anterior profile a continuation of crest; anteroventral filamentous projection slightly up-curved, colorless



Figs. 10–24. *Sweltsa gaufni*, epiproct tip. 10, Dorsal aspect. 11, Dorsolateral aspect. 12, Lateral aspect. 13, Frontal aspect. *Sweltsa albertensis*, epiproct tip, showing individual variation. 14, Dorsal aspect. 15, Dorsolateral aspect. 16, Lateral aspect. 17, Dorsal aspect. 18, Dorsolateral aspect. 19, Lateral aspect. 20, Frontal aspect. *Sweltsa cristata*, epiproct tip. 21, Dorsal aspect and center of transverse ridge of tergum 9. 22, Dorsolateral aspect. 23, Lateral aspect. 24, Frontal aspect.

beyond base. Bulk of epiproct tip concavo-concave; elliptical ventral surface nearly congruent to and aligned with horizontal plane, convex proximally, explanate laterally. Epiproct support structures, segment 9, hemiterga of segment 10 representative of genus. Aedeagus membranous with lightly sclerotized striate crudely square lamella bilobate apically, incurved to half length basally, recurved laterally.

Female.—Body length 8 mm; forewing length 8 mm. Subgenital plate dusky, crudely hexagonal, based centrally on sternite 8, distinguishable anteriorly by narrow membranous periphery; posterior half entire, flap-like, extending over most of sternite 9; middle third from base to apex convex, more hirsute than remainder; profile elevated, a flattened curve. Vagina membranous.

Material.—Holotype ♂, allotype ♀ (U.S. National Museum), paratype 1 ♂ (R. F. Surdick); Utah, San Juan Co., Johnson Crk., Tunnel 19 mi. N. of Blanding [no date] Muliak.

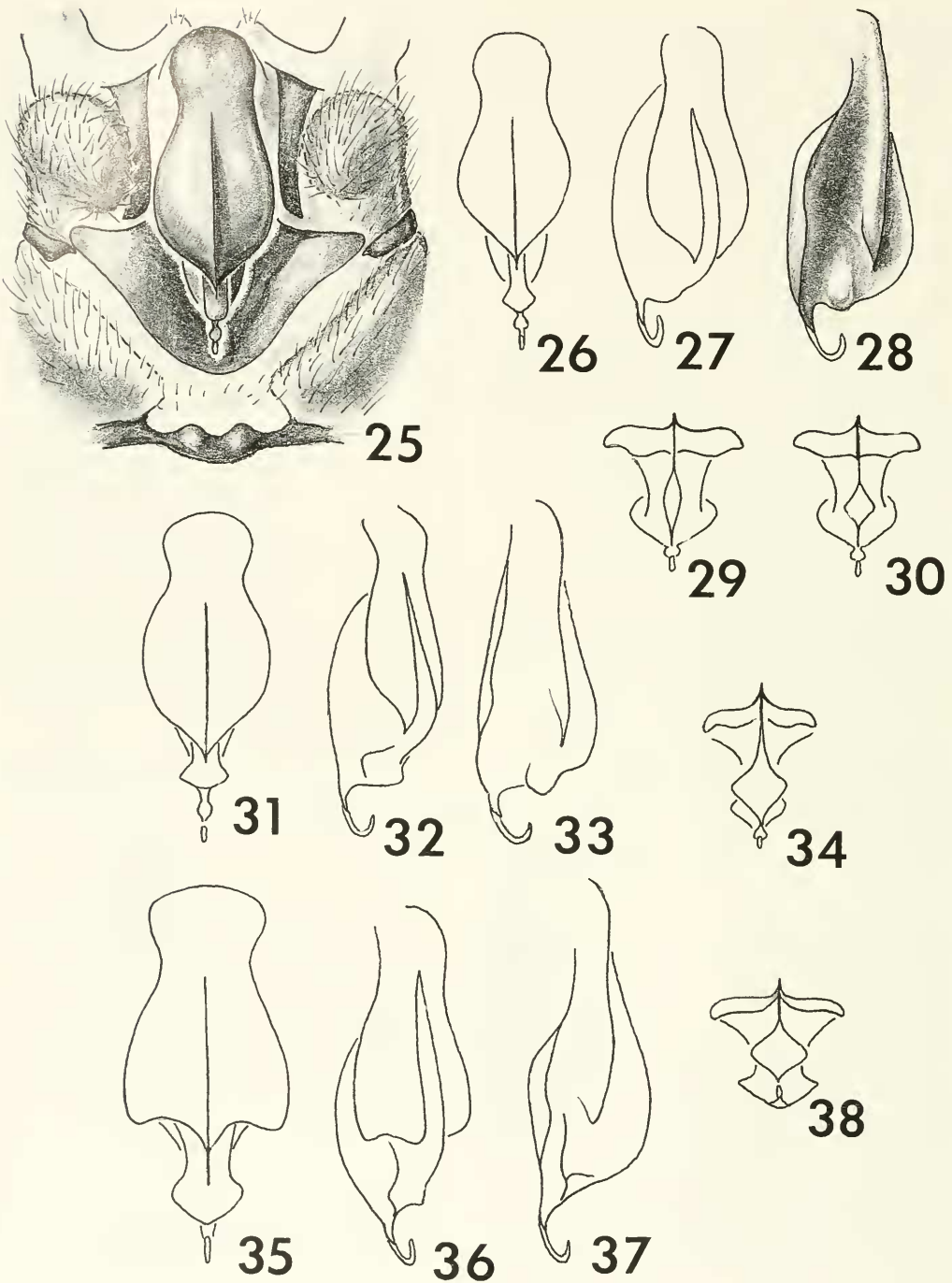
Compared material.—*Sweltsa gaufini*: holotype ♂, allotype ♀ (U.S. National Museum); hundreds of specimens from Idaho, Utah. *Sweltsa albertensis*: topoparatype ♀ (Illinois Natural History Survey); hundreds of specimens from Alberta, British Columbia, Idaho, Montana, Oregon, Wyoming. *Sweltsa lambda*: topoparatype 2 ♂, ♀ (Illinois Natural History Survey, U.S. National Museum); hundreds of specimens from Colorado, Idaho, Oregon, Utah, Wyoming. *Sweltsa hondo*: topoparatype ♂, ♀ (R. F. Surdick); 2 ♀ from New Mexico. (For above species, Brigham Young Univ., California Academy of Science, M. Cather, D. Dunster, Field Museum of Natural History, A. R. Gaufin, Illinois Natural History Survey, S. G. Jewett, Jr., Kansas State Univ., Lyman Museum, Montshire Museum of Science, Oregon State Univ., W. E. Ricker, Royal Ontario Museum, B. P. Stark, R. F. Surdick, Univ. of Kansas, Univ. of Minnesota, U.S. National Museum, Utah State Univ., Washington State Univ.)

Etymology.—The adjective *cristata* describes the crest on the epiproct tip.

Diagnosis.—*Sweltsa cristata* is most closely related to *Sweltsa lambda* (Needham and Claassen 1925) (Figs. 25–34, 41, 45–47), *Sweltsa hondo* Baumann and Jacobi 1984 (Figs. 35–38), *Sweltsa albertensis* (Needham and Claassen) 1925 (Figs. 14–20, 39) and *Sweltsa gaufini* Baumann 1973 (Figs. 10–13). All five species in the *Sweltsa lambda* group have a sclerotized leaflet on the aedeagus that is not found in other *Sweltsa* species. Their elaborately sculptured epiproct tips and their nearly identical female subgenital plates are variations on basic forms that are unique to the group even though similar in some ways to other *Sweltsa* relatives. The epiproct tips are basically concavo-concave rhombohedrons. The upper surface is a curved plane bisected by a longitudinal carina. The sides curve to meet anteriorly at a right or acute angle bearing a swelling or projection. And, a partially colorless filament extends anteriorly from the ventral surface.

In *S. gaufini*, found only in the Bear River area of the northern Wasatch Mountains of Idaho and Utah, the filamentous part of the epiproct tip is a short, slanted blade. The epiproct tip is more elongate than in the other species; the carina is a prominent double crest; the anterior angle bears an oblique hastate projection that is triangular in frontal aspect; the sides are deeply concave, and the ventral surface is half as wide as the dorsal plane. The leaflet on the aedeagus is longer than wide, lightly sclerotized and has rectangular lobes.

In *S. albertensis*, found in the Rocky Mountains of British Columbia, Alberta, Montana, Idaho and northwestern Wyoming, the filament is a long, slanted blade. The dorsal plane is concave and only slightly flanged; the carina is minor, either not reaching all the way to the anterior angle or continuing over the anterior angle, and there is no swelling on the anterior angle but the anterior profile is undercut. The sides are



Figs. 25-38. *Sweltsa lambda* from Wasatch Range, Virgin River drainage of Utah. 25, Male terminalia, dorsal aspect. 26, Epiproct tip, dorsal aspect. 27, Epiproct tip, dorsolateral aspect. 28, Epiproct tip, lateral aspect. 29, Epiproct tip, frontal aspect. 30, Epiproct tip, frontal aspect. *Sweltsa lambda* from Colorado, epiproct tip. 31, Dorsal aspect. 32, Dorsolateral aspect. 33, Lateral aspect. 34, Frontal aspect. *Sweltsa hondo*, epiproct tip. 35, Dorsal aspect. 36, Dorsolateral aspect. 37, Lateral aspect. 38, Frontal aspect.

shallowly concave and the ventral surface is nearly as wide as the dorsal plane and more convex than in the other species. The leaflet on the aedeagus is longer than wide but it is darkly sclerotized and each lobe is rounded.

Sweltsa cristata, *S. lamba* and *S. hondo* are more similar to each other than to either *S. gaufini* or *S. albertensis*. The dorsal plane of each epiproct tip is undulating and broadly pandurate; the carina is a single crest; the slight to prominent projection on the anterior angle is lenticular or diamond-shaped in frontal aspect; the filament is a curled extension on a blade-like base, and the leaflet on the aedeagus is about as long as wide. The middle of the transverse ridge on tergum nine looks like an acutely emarginate triangle in *S. gaufini* and *S. albertensis*. It is crenate in the other four species.

Characters of the epiproct tip and aedeagus distinctly separate *S. cristata* from *S. lamba* and *S. hondo* and indicate that the latter species are more closely related to each other than to *S. cristata*. The anterior part of the pandurate plane of the epiproct tip is nearly elliptical in *S. cristata*; slightly more pyriform and acuminate in *S. lamba*, and nearly triangular in *S. hondo*. The projection at the anterior angle of the bulk of the epiproct tip is minimal in *S. cristata* and visible as a slight swelling in frontal aspect. It is about one-fifth the length of the epiproct tip in the other two species. The ventral surface of the epiproct tip is nearly as wide as and aligned with the dorsal plane in *S. cristata*, but it is more anteriorly placed and narrower than the dorsal plane in the other two species.

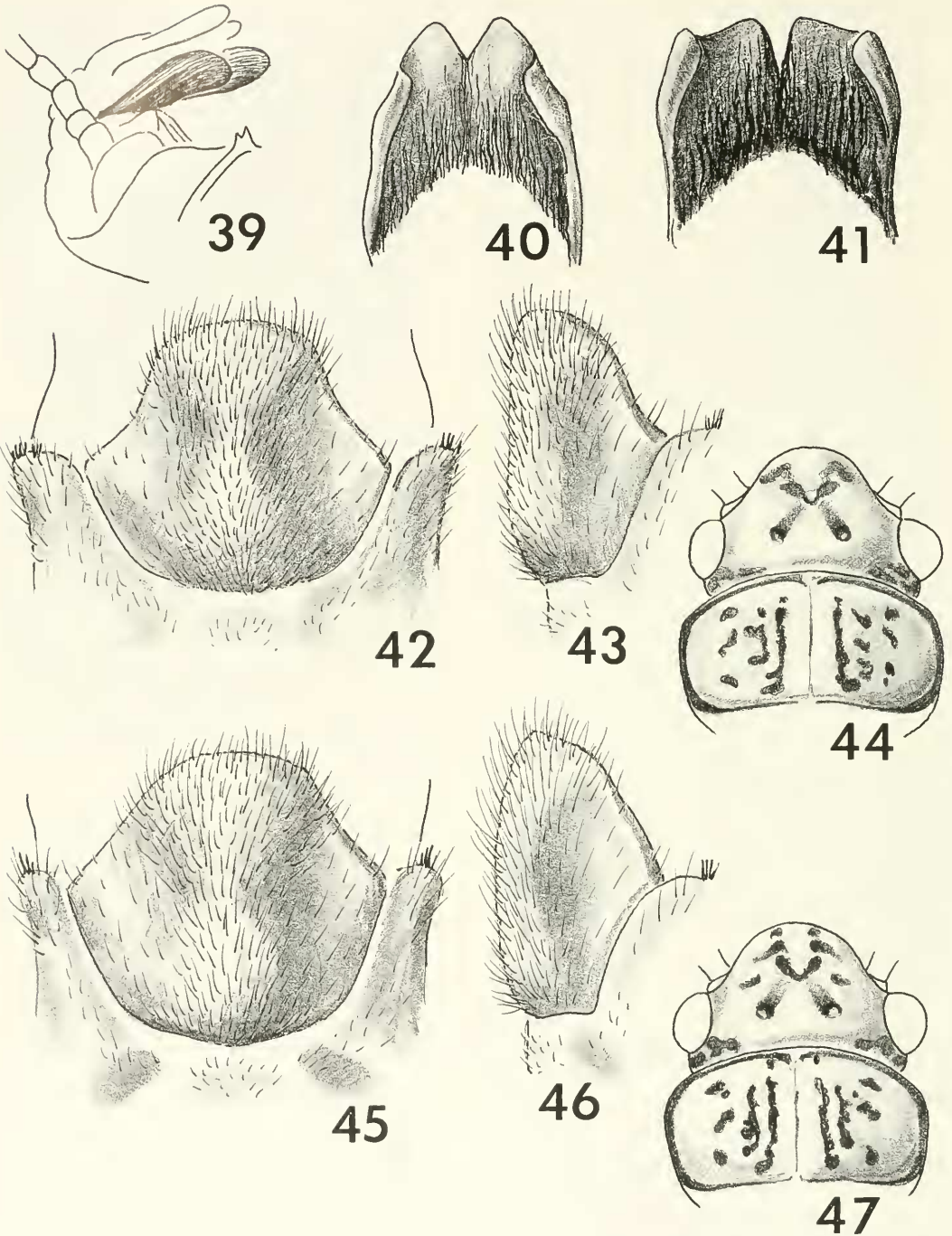
The leaflet on the aedeagus of *S. cristata* is slightly longer than in the other two species and the broader notch in its distal edge bisects it into two rounded lobes. The narrower notch in the leaflets of *S. lamba* and *S. hondo* has only slightly rounded shoulders and bisects a sinuate edge.

Sweltsa cristata has been found in southeastern Utah near Blanding. *Sweltsa lamba*

is a Rocky Mountain species or, more likely, a complex of two incipient or perhaps true species that exhibit considerable variety within and between populations, particularly in the shape and size of the anterior projection of the bulk of the epiproct tip. Utah populations found in the arc of highlands stretching from the Wasatch Mountains to the Virgin River drainage have an anterior projection that is less than half the width of the dorsal plane. In those northern populations the projection is parallel-sided in dorsal aspect and lenticular in frontal aspect (Figs. 25, 29) and in those populations from the Virgin River drainage, it is enlarged anteriorly and lozenged in frontal aspect (Figs. 26–28, 30). Populations from Oregon to Colorado have a projection that is about half to greater than half as wide as the dorsal plane. Again, in those northern populations, the projection is parallel-sided and in Colorado populations, it is enlarged anteriorly (Figs. 31–34). *Sweltsa hondo* has been found in the Sangre de Cristo Range of northcentral New Mexico and differs little from some southern Colorado populations of *S. lamba*.

KEY TO *SWELTSA* MALES WITH A
SCLEROTIZED LAMELLA ON THE
AEDEAGUS

1. Epiproct tip elongate in dorsal aspect with double longitudinal carina; front of bulk of epiproct tip hastate in dorsal aspect, triangular in frontal aspect; lamella on aedeagus longer than wide with rectangular lobes (Figs. 10–13) *gaufini*
 - Epiproct tip with dorsal pandurate plane, single longitudinal carina; front of bulk of epiproct tip parallel-sided or anteriorly swollen in dorsal aspect, lozenged or lenticular in frontal aspect or wedge-like; lamella on aedeagus longer than wide with excurved lobes or as long as wide 2
2. Dorsal plane of epiproct tip slightly concave with carina minor and not usually rising above concavity; front of bulk of epiproct tip perpendicular or slightly undercut in profile, wedge-like in frontal aspect; lamella on aedeagus longer than wide with excurved lobes (Figs. 14–20, 39) *albertensis*
 - Dorsal plane of epiproct tip slightly convex with carina a prominent crest; projected front



Figs. 39-47. 39, *Sweltsa albertensis*, male terminalia and aedeagus, dorsolateral aspect. 40, *Sweltsa cristata*, lamella of aedeagus. 41, *Sweltsa lamba*, lamella of aedeagus. *Sweltsa cristata*. 42, Subgenital plate of female, ventral aspect. 43, Subgenital plate, lateral aspect. 44, Adult head and pronotum. *Sweltsa lamba*. 45, Subgenital plate of female, ventral aspect. 46, Subgenital plate, lateral aspect. 47, Adult head and pronotum.

- of bulk of epiproct tip parallel-sided or anteriorly swollen in dorsal aspect, lozenged or lenticular in frontal aspect; lamella on aedeagus as long as wide 3
3. Projection of bulk of epiproct tip as long as wide and visible as slight swelling in dorsal aspect; ventral surface of epiproct tip as wide as and aligned with dorsal plane (Figs. 21-24) *crinata*
- Projection of bulk of epiproct tip longer than wide and about one-fifth length of epiproct tip in dorsal aspect; ventral surface of epiproct tip narrower than and staggered anteriorly to dorsal plane 4
4. Dorsal plane of epiproct tip pyriform and anteriorly acuminate (Figs. 25-34) *lambda*
- Dorsal plane of epiproct tip nearly triangular (Figs. 35-38) *hondo*

***Sweltsa umbonata*, sp. nov.**

Figs. 48-54

Adult.—General color dusky-marked pale tan in alcohol. Head with 3 dark ocellar rings, dusky rugulae anterior to and adjacent to ocellar triangle and posterior to compound eyes; posterior ocelli connected to anterior ocellus by diffuse dusky V-mark. Pronotum with thin dark encircling line, dusky longitudinal rugulae. Meso- and metanota each with dark recurrent scutocutellar suture. Abdomen with dark median longitudinal stripe from tergum 1 to 8, single dusky lateral stripes from segment 1 to 4, lateral pectens on segments 7, 8, 9. Macropterous; wings hyaline, dusky-veined, representative of genus.

Female.—Body length 11 mm; forewing length 11 mm. Subgenital plate slightly dusky, crudely hexagonal, umbonate, based centrally on sternite 8, two-thirds as long as wide, distinguishable anteriorly by narrow membranous periphery; posterior half flap-like, extending over most of sternite 9. Emargination on posterior of plate nearly quadrate with slight interior convexity; each consequent lateral flap thin, flat, trapeziform, narrowed posteriorly, one-fifth length of plate, half as wide as emargination, pointing posteromedial. Tumulus centered on triangular convexity that longitudinally spans middle third of plate prominent, de-

clivent anteriorly, steeply sloped laterally, precipitous posteriorly. Plate thickly hirsute on tumulus and anterior declivity with hairs longer, more posteriorly directed approaching summit; remainder sparsely hirsute with fine, pale hairs. Vagina membranous.

Male.—Body length 10 mm; forewing length 10 mm. Epiproct sclerotized, hinged, with tip extending anteriorly to prominent sclerotized shallowly crenate transverse ridge on anterior of tergum 9. In dorsal aspect, epiproct tip 9 times longer than wide, slightly widened at base and at two-thirds length, with distal quarter acuminate. In lateral aspect, epiproct tip 12 times longer than thick, parallel-sided, slightly cernuous at two-thirds length, with apex circular and slightly broader than remainder. Epiproct support structures, segment 9, hemiterga of segment 10 representative of genus. Aedeagus membranous.

Material.—Holotype ♀, allotype ♂ (U.S. National Museum), paratype 9 ♂, 7 ♀ (U.S. National Museum): California, Shasta Co., Fowlers Campground, McCloud R. 6-VI-1965 S. G. Jewett, Jr. Paratypes: 4 ♂, 2 ♀ (U.S. National Museum) California, Siskiyou Co., Mt. Shasta, head Sacramento R. 29-V-1967 S. G. Jewett, Jr.; 7 ♂, 4 ♀ (U.S. National Museum, R. F. Surdick) same locality 5-VI-1965 S. G. Jewett, Jr.; 2 ♂, 1 ♀ (U.S. National Museum) same locality 18-VI-1967 E. Evans.

Compared material.—See compared material of *Sweltsa adamantea*, sp. nov. below.

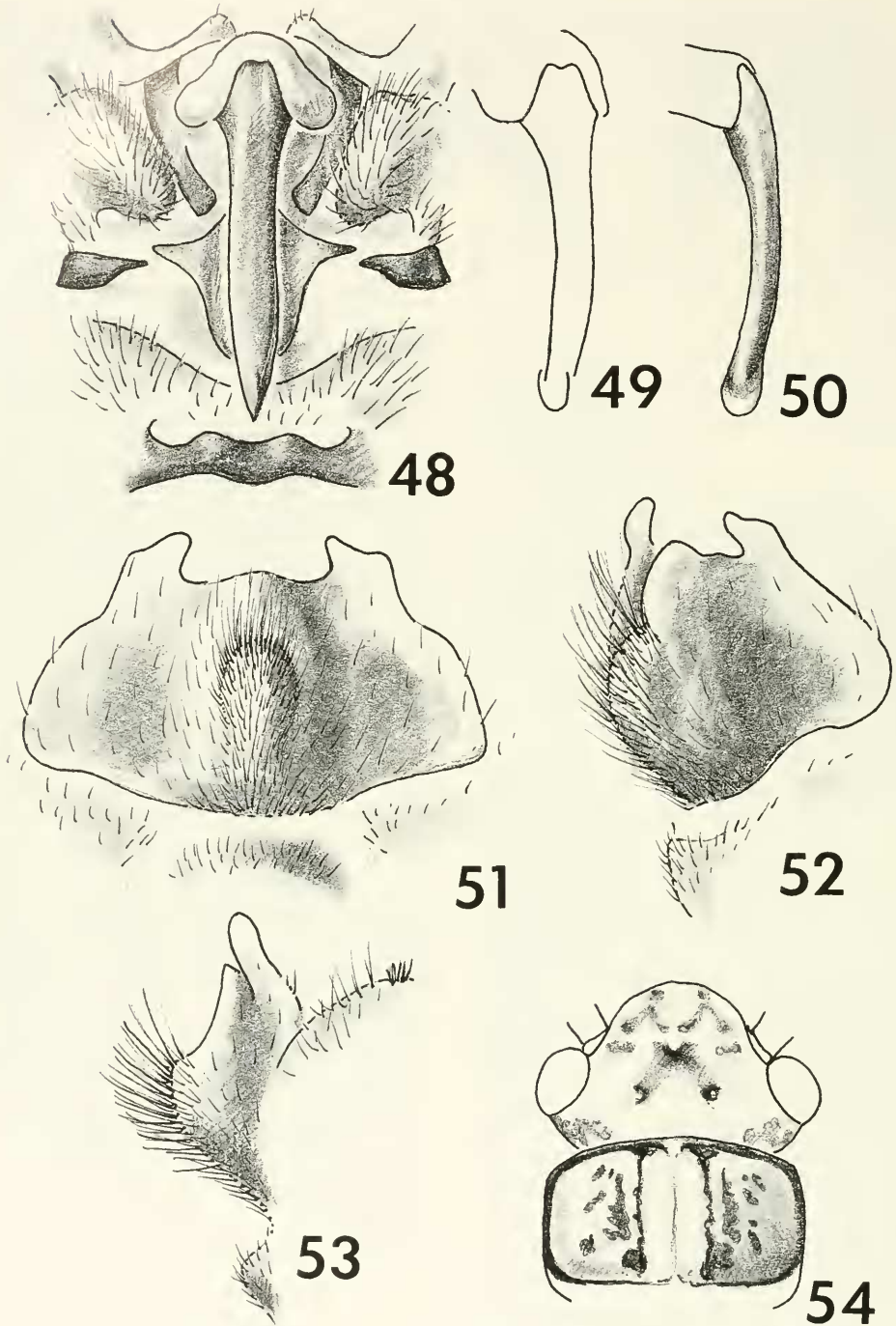
Etymology.—The adjective *umbonata* describes the distinctive appearance of the subgenital plate. The tumulus resembles a boss at the center of a shield.

Diagnosis.—See diagnosis of *Sweltsa adamantea*, sp. nov. below.

***Sweltsa adamantea*, sp. nov.**

Figs. 55-61

Adult.—General color darkly-marked tan in alcohol. Head with 3 dark ocellar rings, dark rugulae anterior to and adjacent to ocellar triangle and posterior to compound



Figs. 48-54. *Sweltsa umbonata*. 48, Male terminalia, dorsal aspect. 49, Epiproct tip, dorsolateral aspect. 50, Epiproct tip, lateral aspect. 51, Subgenital plate of female, ventral aspect. 52, Subgenital plate, ventrolateral aspect. 53, Subgenital plate, lateral aspect. 54, Adult head and pronotum.

eyes; most of frons, ocellar triangle and rugose areas dark. Pronotum with thin dark encircling line, dark longitudinal rugulae in dusky environs. Meso- and metanota dusky, each with dark recurrent scutoscuteellar suture. Abdomen with dark median longitudinal stripe from tergum 1 to 8, single dark lateral stripes from segment 1 to 3, lateral pectens on segments 7, 8, 9. Wings macropterous to brachypterous, hyaline, dark-veined, representative of genus.

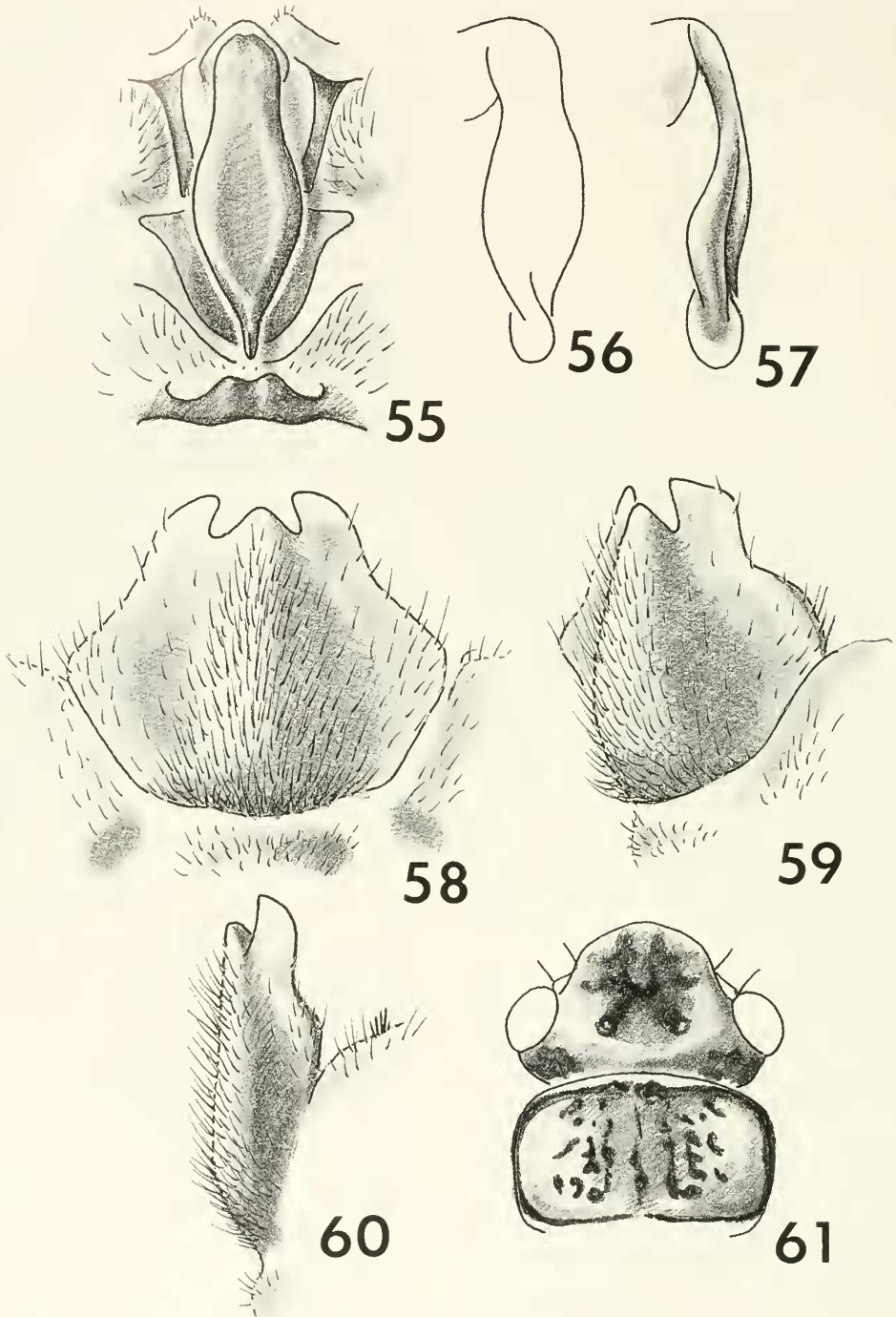
Male.—Body length 9 mm; forewing length of holotype 8 mm. Epiproct sclerotized, hinged, with tip extending anteriorly to prominent sclerotized, shallowly crenate transverse ridge on anterior of tergum 9. In dorsal aspect, epiproct tip thrice longer than wide, an elongate lozenge with obtuse angles rounded, surface slightly depressed centrally, verge curved ventrad; apex bluntly acute, compressed with dorsal edge appearing as short bisecting line. In lateral aspect, epiproct tip with thickness less than half width, slightly declivent and thickened medially; apex one-fifth epiproct tip length, a colorless crescent, paddle-like with vertical elliptical blade slightly broader than thickness of bulk of tip, arising anteromedially from dorsal and ventral surfaces of bulk. Epiproct support structures, segment 9, hemiterga of segment 10 representative of genus. Aedeagus membranous.

Female.—Body length 11 mm; forewing length 10 mm. Subgenital plate slightly dusky, crudely hexagonal, based centrally on sternite 8, almost as long as wide, distinguishable anteriorly by narrow membranous periphery; posterior half flap-like, extending over most of sternite 9. Emargination on posterior of plate bisected by slightly obtuse angular projection; each consequent lateral flap thin, flat, trapeziform, narrowed posteriorly, pointing posteromedially, one-sixth length of plate, one-third longer than interposed angle, half as wide as emargination. Median triangular convexity longitudinally spanning middle third of plate based anteriorly, terminated pos-

teriorly as angular projection, a plateau in profile, thickly hirsute; remainder of plate sparsely hirsute with fine hairs more numerous laterally. Vagina membranous.

Material.—Holotype ♂, allotype ♀ (U.S. National Museum), paratype 1 ♂, 1 ♀ (R. F. Surdick): Oregon, Yamhill Co., McMinnville, Peavine Ridge 8-VI-1948 K. M. Fender. Additional material: 1 ♂ (S. G. Jewett, Jr.) Oregon, Benton Co., Wren; 1 ♂ (U.S. National Museum) Washington, Grays Harbor Co., Humptulips.

Compared material.—*Sweltsa borealis*: lectotype ♀, cotypes (Museum of Comparative Zoology); hundreds of specimens from Alaska, Alberta, British Columbia, California, Colorado, Idaho, Montana, Oregon, Utah, Washington, Wyoming, Yukon. *Sweltsa fidelis*: lectotype ♀, cotypes (Museum of Comparative Zoology); hundreds of specimens from Alberta, British Columbia, California, Colorado, Idaho, Montana, Oregon, Washington, Wyoming, Yukon. *Sweltsa revelstoka*: holotype ♀, allotype ♂ (W. E. Ricker); hundreds of specimens from Alberta, British Columbia, Montana, Oregon, Washington, Wyoming. (Above species, Brigham Young Univ., California Academy of Science, M. Cather, D. Dunster, A. R. Gaufin, Field Museum of Natural History, R. E. Hill, Illinois Natural History Survey, S. G. Jewett, Jr., Michigan State Univ., Montshire Museum of Science, Oregon State Univ., W. E. Ricker, Royal Ontario Museum, B. P. Stark, R. F. Surdick, Univ. of Alberta, Univ. of British Columbia, Univ. of Kansas, Univ. of Minnesota, Univ. of Montana, Univ. of Nebraska, U.S. National Museum, Utah State Univ., Washington State Univ., R. Wisseman.) *Sweltsa continua*: lectoallotype ♀, cotypes (Museum of Comparative Zoology); specimens from Los Angeles, Riverside, San Bernardino, San Diego Cos., California (Brigham Young Univ., California Academy of Science, Field Museum of Natural History, S. G. Jewett, Jr.). *Sweltsa californica*: holotype ♂ (California Academy of Science); specimens from



Figs. 55-61. *Sweltsa adamantea*. 55, Epiproct and center of transverse ridge on tergum 9, dorsal aspect. 56, Epiproct tip, dorsolateral aspect. 57, Epiproct tip, nearly lateral aspect. 58, Subgenital plate of female, ventral aspect. 59, Subgenital plate, ventrolateral aspect. 60, Subgenital plate, lateral aspect. 61, Adult head and pronotum.

Butte, Placer Cos., California (California Academy of Science, R. E. Hill).

Etymology.—The adjective *adamantea* describes the rhomboid dorsal aspect of the epiproct tip.

Diagnosis.—*Sweltsa umbonata* and *S. adamantea* are closely related to *Sweltsa borealis* (Banks) 1895 (Figs. 62–65), *Sweltsa fidelis* (Banks) 1920 (Figs. 66–70), and *Sweltsa revelstoka* (Jewett) 1955 (Figs. 71–74). All these western Nearctic species have a similarly elongate, club-like or slightly flattened epiproct tip and an emarginate, approximately hexagonal female subgenital plate. They have a median convexity on the subgenital plate that either does not extend posteriorly as far as the emargination or does not project beyond the lateral flaps formed by the emargination. In the latter case, the projected portion, whether acute, obtuse or slight, is about twice as broad as a lateral flap.

Sweltsa continua (Banks) 1911 (Figs. 75–79, 85) and *Sweltsa californica* (Jewett) 1965 (Figs. 80–84, 86) also have an emarginate subgenital plate and are included in the *Sweltsa borealis* group but are more distantly related. Both species have a broad median convexity on the subgenital plate that projects beyond the lateral flaps, a distinctly sculptured epiproct tip and a pronounced median dark stripe on the pronotum.

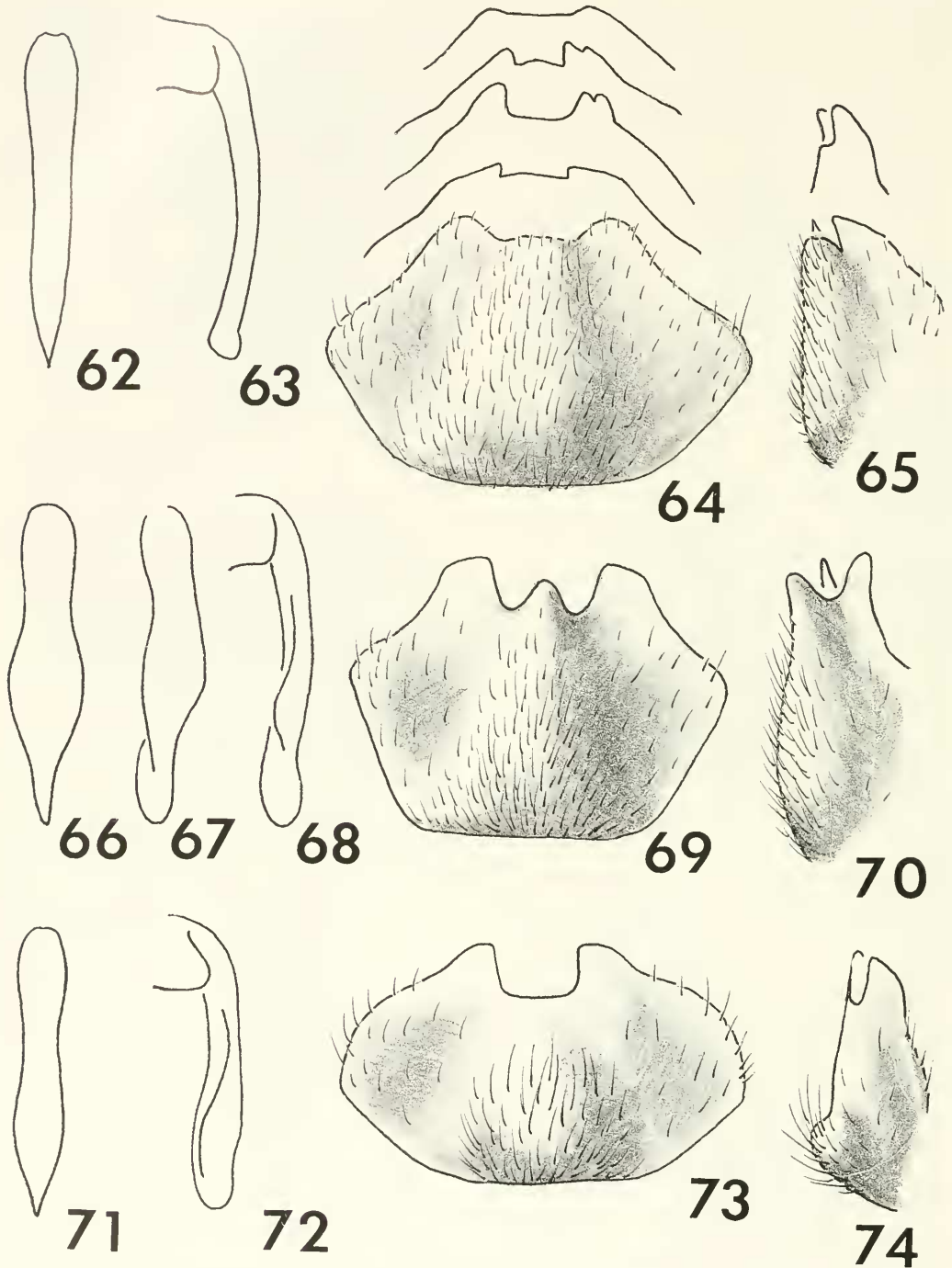
The five species that include *S. umbonata* and *S. adamantea* differ from each other in the shapes of the median convexity and lateral flaps of the subgenital plate, in the setation of the subgenital plate, in the location and width of the widest or flattest part of the epiproct tip, and in the prominence of the compressed apex of the epiproct tip. Some species have a consistent color pattern that can be an aid in determining them.

The subgenital plate of all five species bears a triangular convexity on the middle third. In *S. borealis*, *S. fidelis* and *S. adamantea*, the convexity is shallow and plateau-like in profile but it obviously swells

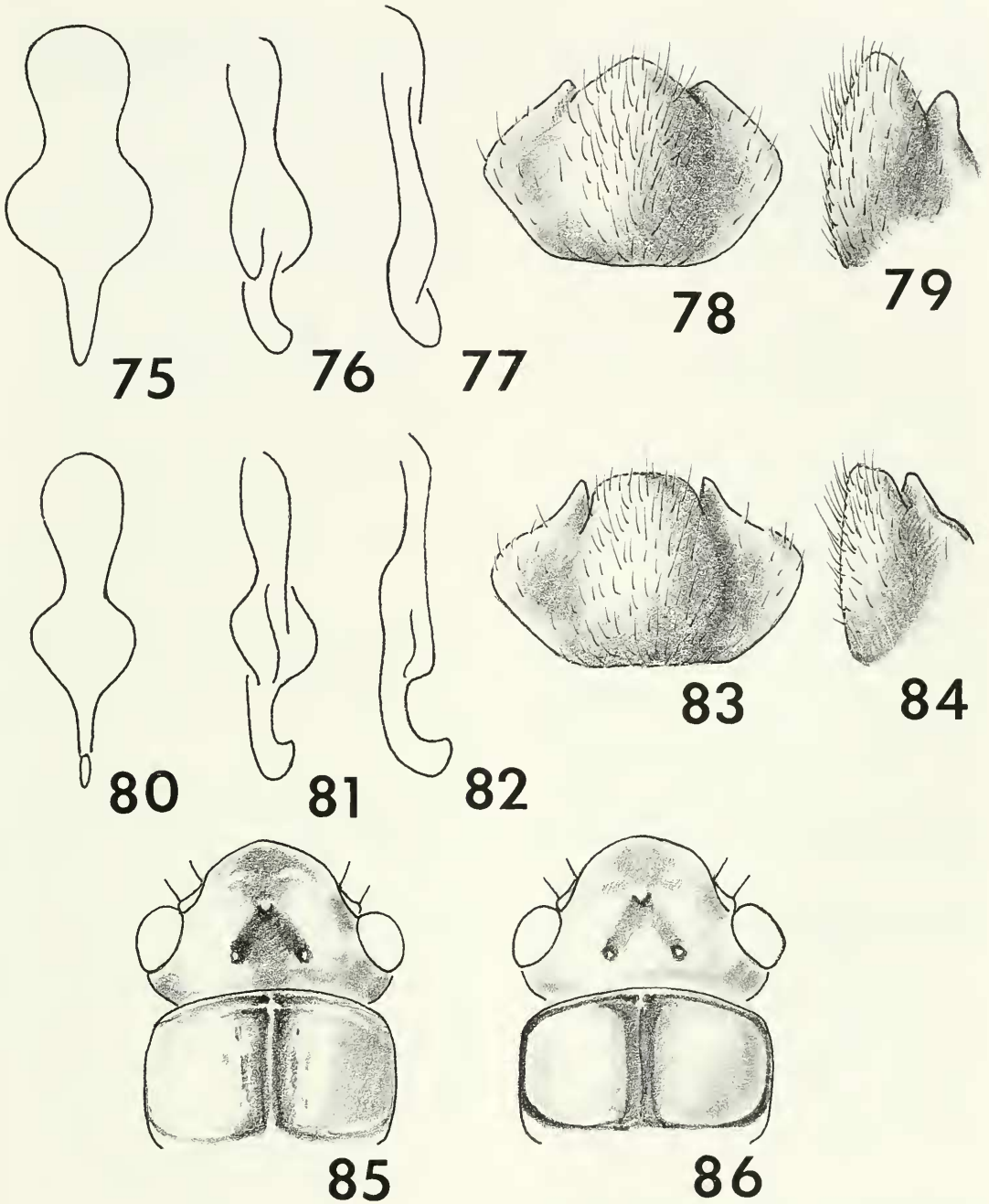
above the sparsely haired lateral thirds that terminate in the thin flaps flanking the emargination. The convexity, or at least its anterior two-thirds, is more hirsute than the remainder of the plate. In *S. borealis*, the convexity is usually only slightly projected as a small curve or very obtuse angle in the emargination between the lateral flaps. In *S. fidelis* and *S. adamantea*, the convexity is usually slightly deeper than in *S. borealis* and, projecting between the flaps as a nearly right angle, extends half as to almost as far as the flaps extend. In *S. umbonata*, the convexity itself is not pronounced and it projects in the emargination as a slight broad curve. But, there is a prominent boss on the center of the convexity. The boss and the anterior of the convexity where it slopes down from the boss is thickly hirsute with long hairs. In *S. revelstoka*, the convexity is usually pronounced but reaches posteriorly from the base to only about midway on the plate so it does not project in the square emargination. It is thickly hirsute with long hairs.

In *S. borealis*, the lateral flaps that flank the emargination of the subgenital plate are usually more circular or square than trapeziform and are often slightly notched or scalloped. They range from small out-curves on the posterior margin of the plate to distinct flaps one-fifth the length of the plate. Their shape and length often differ within and between populations. As a pair, they occasionally exhibit asymmetry and aberrations of shape or development. In *S. fidelis* and *S. adamantea*, the flaps are trapeziform, often point posteromedially and constitute about one-fifth the length of the plate. In *S. revelstoka*, the flaps, although also trapeziform and about one-fifth the length of the plate, do not arise as distinctly from the lateral margins of the plate. This gives the plate the appearance of an oblate hexagon with rounded angles and with a prominent, round-shouldered, square notch in its posterior margin.

In all five species, the epiproct tip is to



Figs. 62-74. *Sweltsa borealis*. 62, Epiproct tip, dorsal aspect. 63, Epiproct tip, lateral aspect. 64, Subgenital plate of female and variations, ventral aspects. 65, Subgenital plate and variation, lateral aspects. *Sweltsa fidelis*. 66, Epiproct tip, dorsal aspect. 67, Epiproct tip, dorsolateral aspect. 68, Epiproct tip, lateral aspect. 69, Subgenital plate of female, ventral aspect. 70, Subgenital plate, lateral aspect. *Sweltsa revelstoka*. 71, Epiproct tip, dorsal aspect. 72, Epiproct tip, lateral aspect. 73, Subgenital plate of female, ventral aspect. 74, Subgenital plate, lateral aspect.



Figs. 75-86. *Sweltsa continua*. 75, Epiproct tip, dorsal aspect. 76, Epiproct tip, dorsolateral aspect. 77, Epiproct tip, lateral aspect. 78, Subgenital plate of female, ventral aspect. 79, Subgenital plate, lateral aspect. *Sweltsa californica*. 80, Epiproct tip, dorsal aspect. 81, Epiproct tip, dorsolateral aspect. 82, Epiproct tip, lateral aspect. 83, Subgenital plate of female, ventral aspect. 84, Subgenital plate, lateral aspect. 85, *Sweltsa continua*, adult head and pronotum. 86, *Sweltsa californica*, adult head and pronotum.

some extent flattened for most of its length and compressed at its partly colorless tip. In *S. borealis*, it is one-tenth to one-eighth as wide and as thick as long, only barely flattened anywhere along its length, slightly declivent, and nearly parallel-sided with its apical quarter acuminate in dorsal aspect. Its apex is rounded in profile and as thick as or slightly thicker than the bulk of the epiproct tip. Its shape differs within and between populations. The epiproct tip of *S. umbonata* is similar to that of *S. borealis*, but it increases slightly in width at two-thirds its length, is more declivent and has an apex slightly larger in profile.

In *S. fidelis*, *S. revelstoka* and *S. adamantea*, the epiproct tip is wider and slightly thicker with a more pronounced apex than in the above two species. It widens and narrows along its length. Because the compressed apex arises from the dorsal and ventral surfaces, the epiproct tip resembles a large horizontal rhomboidal disk intersected on its apex by a small vertical elliptical disk for half the diameter of the small disk. In *S. fidelis*, the epiproct tip reaches its greatest width, almost one-fourth its length, at about three-fifths its length. Its sides are slightly incurved from base to widest part and it is acuminate beyond. In *S. revelstoka*, the epiproct tip reaches its greatest width, about one-sixth its length, at three-fourths its length. Its sides are also slightly incurved from base to widest part and it is acuminate beyond. In *S. adamantea*, the epiproct tip reaches its greatest width, about one-third its length, at about half its length. Its sides are slightly incurved only adjacent to the base; beyond that, its sides are slightly excurved and it ends acutely.

Sweltsa borealis is usually the largest of the Chloroperlinae and macropterous but its body length and wing length differ within and between populations. The crenulations on the transverse ridge are often comparatively very shallow. *Sweltsa revelstoka*, although other macropterous, commonly exhibits different degrees of brachyptery. The

S. adamantea examined are macropterous and brachypterous. *Sweltsa fidelis* is usually macropterous and the *S. umbonata* examined are macropterous.

Sweltsa borealis differs, sometimes greatly, in adult coloration and distinctness of color pattern within and between populations. But, whether pale or dark overall, the rugulae of the head and pronotum are darkened, the posterior ocelli are usually connected to the anterior ocellus by a dark V and the pronotum is ringed by a dark line. *Sweltsa umbonata*, *S. revelstoka* and *S. adamantea* are usually darkly and distinctly colored in the same pattern as *S. borealis*. In *S. revelstoka* and even darker *S. adamantea*, however, a broad dark area on the head usually extends from the ocellar triangle to the clypeus. *Sweltsa fidelis* differs in coloration within and between populations but it is usually pale overall. The rugulae are barely noticeable or darkened, the ocelli are usually not connected by a dark V and the dark ring on the pronotum is often interrupted, forming a pair of lateral crescents.

Sweltsa borealis is a common, wide-ranging species. It has been found from Alaska to New Mexico and to California. *Sweltsa fidelis* ranges from Alaska to Utah and to California and *S. revelstoka* ranges from Alberta and British Columbia to Wyoming and Oregon. *Sweltsa adamantea* has been found in areas of the Coast Ranges of northern Oregon and Washington. *Sweltsa umbonata* has been found in the Mount Shasta area of California between the southern Cascade Range and northern Sierra Nevada.

KEY TO NEARCTIC *SWELTSA* WITH THE SUBGENITAL PLATE OF THE FEMALE EMARGINATE

1. Median longitudinal dark stripe on pronotum; in dorsal aspect, epiproct tip narrowed to less than basal width at one-third length, abruptly widened to wider than base in middle third then abruptly and sharply acuminate; median convexity on female subgenital plate projecting posteriorly between emargination to or beyond

- apices of lateral flaps where it is at least half width of posterior margin of plate 2
- Median longitudinal area of pronotum pale; in dorsal aspect, epiproct tip nearly parallel-sided, slightly widened or gradually widened to up to twice basal width then gradually tapered to apex or acuminate; median convexity on female subgenital plate either not extending posteriorly as far as emargination or not extending beyond apices of lateral flaps where it is less than half width of posterior margin of plate 3
- 2. Dark ring encircling pronotum; apex of epiproct tip up-curved, hook-like; median convexity of subgenital plate blunt, extending slightly beyond apices of lateral flaps (Figs. 80-84, 86) *californica*
- No dark ring encircling pronotum; apex of epiproct tip up-curved, blunt; median convexity of subgenital plate rounded, extending beyond apices of lateral flaps (Figs. 75-79, 85) *continua*
- 3. Epiproct tip nearly parallel-sided, acuminate distally; lateral flaps of subgenital plate more square or rounded 4
- Epiproct tip widened somewhere along its length, acuminate or acute distally; lateral flaps of subgenital plate more trapeziform 5
- 4. Median convexity of subgenital plate with prominent central hirsute boss (Figs. 48-54) ..
..... *umbonata*
- Median convexity of subgenital plate without a boss (Figs. 62-65) *borealis*
- 5. Median convexity of subgenital plate prominent, reaching from base to midway on plate; epiproct tip reaching greatest width at about three-fourths its length (Figs. 71-74) .. *revelstoka*
- Median convexity of subgenital plate extending length of plate and projecting as an obtuse angle in the emargination between the lateral flaps; epiproct tip reaching greatest width at about three-fifths or one-half its length 6
- 6. Epiproct tip reaching its greatest width, almost one-fourth its length, at about three-fifths its length; epiproct tip acuminate with sides slightly incurved; ocelli usually not connected by dark V (Figs. 66-70) *fidelis*
- Epiproct tip reaching its greatest width, almost one-third its length, at about half its length; epiproct tip acute apically with sides slightly excurved; ocelli connected by dark V and dark area reaching to clypeus (Figs. 55-61)
..... *adamantea*

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